🔍 Ridge Regression – Grid Search for Optimal Alpha

This document summarizes the process and results of applying Grid Search with Ridge Regression on the California Housing dataset.  
GridSearchCV was used to identify the optimal value of alpha (regularization strength) using 5-fold cross-validation.

# 🎯 Why Use Grid Search?

- Grid Search automates hyperparameter tuning by testing a defined set of alpha values.  
- It uses cross-validation to evaluate each model's performance more reliably.  
- This prevents overfitting to a single train/test split and ensures a more generalizable model.

# ✅ Grid Search Output

- Best Alpha: 0.1  
- MAE: 0.5332  
- MSE: 0.5559  
- RMSE: 0.7456  
- R² Score: 0.5758

# 📊 Coefficients with Best Alpha (0.1)

MedInc: 0.8524

HouseAge: 0.1224

AveRooms: -0.3051

AveBedrms: 0.3711

Population: -0.0023

AveOccup: -0.0366

Latitude: -0.8966

Longitude: -0.8689

# 📌 Interpretation

- Grid Search selected alpha = 0.1 as optimal, confirming that only mild regularization is needed for this dataset.  
- The resulting Ridge model retained all features and achieved performance identical to the plain Linear Regression model.  
- This validates that the model is well-balanced and not overfitting, but the regularization provides slight robustness.